

# International IOR Rectifier

## REPETITIVE AVALANCHE AND $dv/dt$ RATED HEXFET<sup>®</sup> TRANSISTORS THRU-HOLE (TO-204AA/AE)

## IRF054 60V, N-CHANNEL

### Product Summary

Part Number	BVDSS	RDS(on)	Id
IRF054	60V	0.022 $\Omega$	45A*

The HEXFET<sup>®</sup> technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry and unique processing of this latest "State of the Art" design achieves: very low on-state resistance combined with high transconductance; superior reverse energy and diode recovery  $dv/dt$  capability.

The HEXFET transistors also feature all of the well established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling and temperature stability of the electrical parameters.

They are well suited for applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers and high energy pulse circuits.



TO-3

### Features:

- Repetitive Avalanche Ratings
- Dynamic  $dv/dt$  Rating
- Hermetically Sealed
- Simple Drive Requirements
- Ease of Paralleling

### Absolute Maximum Ratings

	Parameter		Units
$I_D$ @ $V_{GS} = 0V$ , $T_C = 25^\circ C$	Continuous Drain Current	45*	A
$I_D$ @ $V_{GS} = 0V$ , $T_C = 100^\circ C$	Continuous Drain Current	31	
$I_{DM}$	Pulsed Drain Current ①	220	
$P_D$ @ $T_C = 25^\circ C$	Max. Power Dissipation	150	W
	Linear Derating Factor	1.2	W/ $^\circ C$
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy ②	480	mJ
$I_{AR}$	Avalanche Current ①	-	A
$E_{AR}$	Repetitive Avalanche Energy ①	-	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ ③	4.5	V/ns
$T_J$	Operating Junction	-55 to 150	$^\circ C$
$T_{STG}$	Storage Temperature Range		
	Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)	
	Weight	11.5(typical)	g

\* Current limited by pin diameter.

For footnotes refer to the last page

**Electrical Characteristics @ T<sub>j</sub> = 25°C (Unless Otherwise Specified)**

	Parameter	Min	Typ	Max	Units	Test Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	60	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
ΔBV <sub>DSS</sub> /ΔT <sub>j</sub>	Temperature Coefficient of Breakdown Voltage	—	0.68	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	0.022	Ω	V <sub>GS</sub> = 10V, I <sub>D</sub> = 31A ④
		—	—	0.025		V <sub>GS</sub> = 10V, I <sub>D</sub> = 45A ④
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
g <sub>fs</sub>	Forward Transconductance	20	—	—	S (Ω)	V <sub>DS</sub> > 15V, I <sub>DS</sub> = 31A ④
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	25	μA	V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V
		—	—	250		V <sub>DS</sub> = 48V V <sub>GS</sub> = 0V, T <sub>j</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	—	-100		V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	80	—	180	nC	V <sub>GS</sub> = 10V, I <sub>D</sub> = 45A V <sub>DS</sub> = 30V
Q <sub>gs</sub>	Gate-to-Source Charge	20	—	45		
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	34	—	105		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	33	ns	V <sub>DD</sub> = 30V, I <sub>D</sub> = 45A, R <sub>G</sub> = 2.35Ω
t <sub>r</sub>	Rise Time	—	—	180		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	100		
t <sub>f</sub>	Fall Time	—	—	100		
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	6.1	—	nH	Measured from drain lead (6mm/0.25in. from package) to source lead (6mm/0.25in. from package)
C <sub>iss</sub>	Input Capacitance	—	4600	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	2000	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	340	—		

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	45 *	A	
I <sub>SM</sub>	Pulse Source Current (Body Diode) ①	—	—	220		
V <sub>SD</sub>	Diode Forward Voltage	—	—	2.5	V	T <sub>j</sub> = 25°C, I <sub>S</sub> = 45A, V <sub>GS</sub> = 0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	—	280	nS	T <sub>j</sub> = 25°C, I <sub>F</sub> = 45A, di/dt ≤ 100A/μs V <sub>DD</sub> ≤ 50V ④
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	2.2	μC	
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L <sub>S</sub> + L <sub>D</sub> .				

\*Current limited by pin diameter.

**Thermal Resistance**

	Parameter	Min	Typ	Max	Units	Test Conditions
R <sub>thJC</sub>	Junction to Case	—	—	0.83	°C/W	
R <sub>thJA</sub>	Junction to Ambient	—	—	30		Typical socket mount

For footnotes refer to the last page

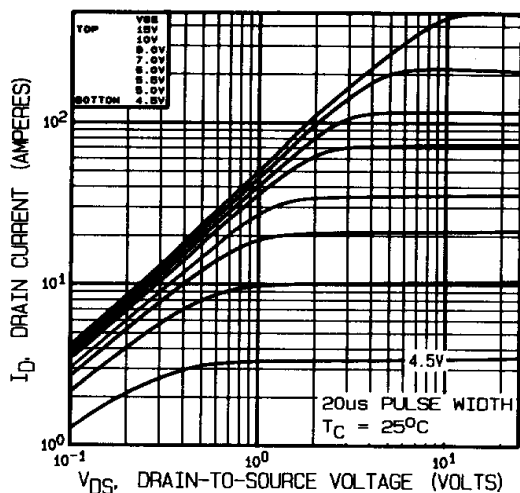


Fig 1. Typical Output Characteristics

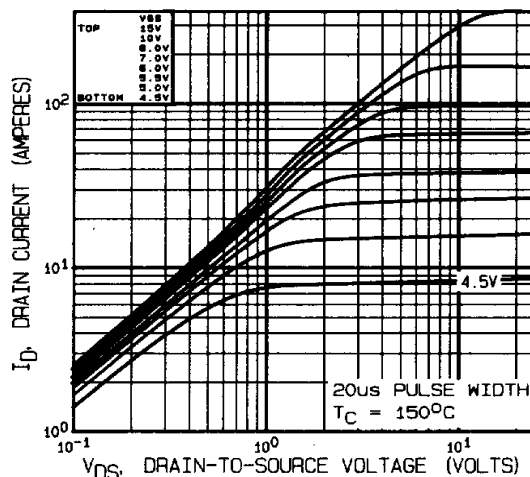


Fig 2. Typical Output Characteristics

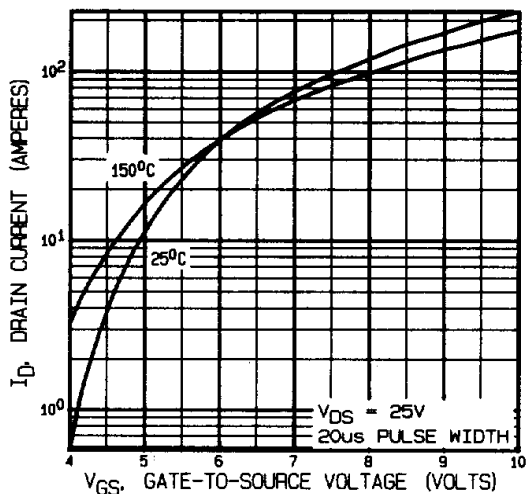


Fig 3. Typical Transfer Characteristics

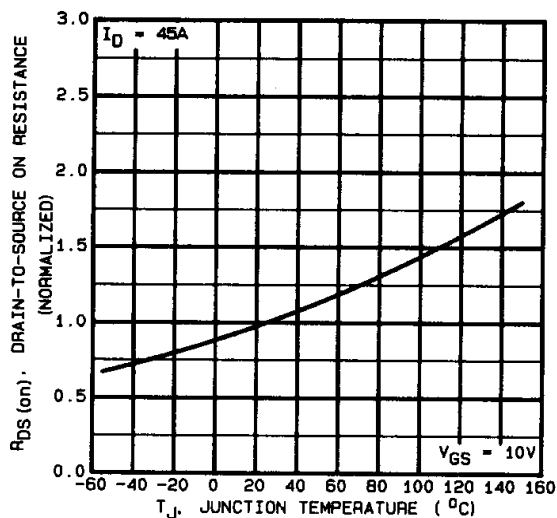


Fig 4. Normalized On-Resistance  
Vs. Temperature

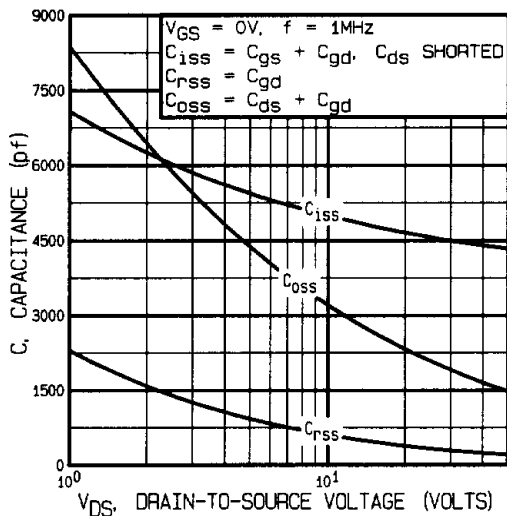


Fig 5. Typical Capacitance Vs.  
Drain-to-Source Voltage

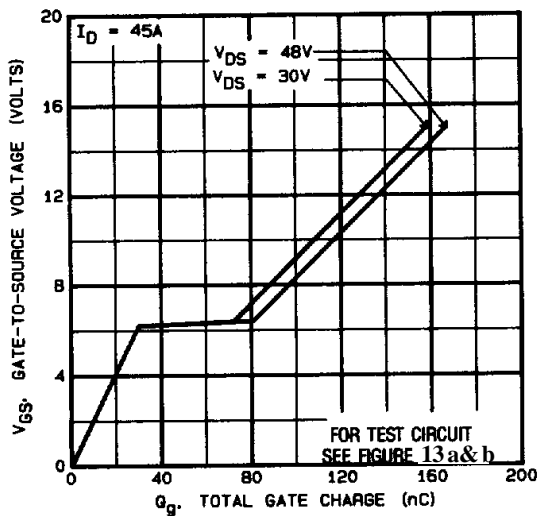


Fig 6. Typical Gate Charge Vs.  
Gate-to-Source Voltage

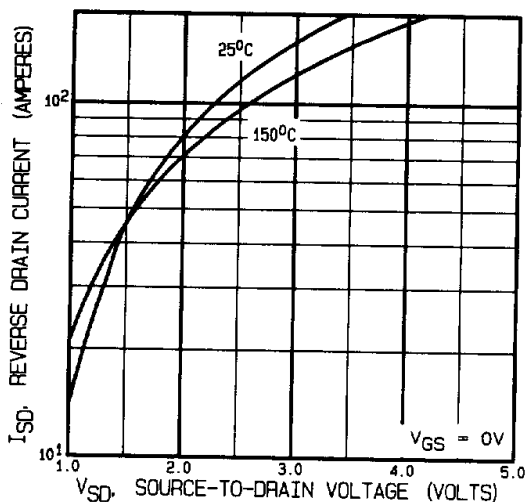


Fig 7. Typical Source-Drain Diode  
Forward Voltage

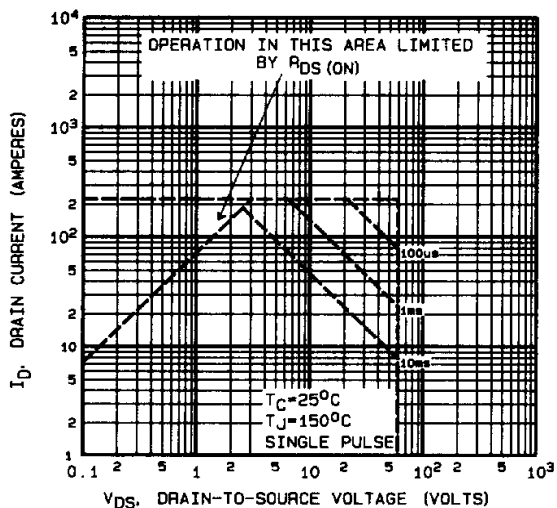
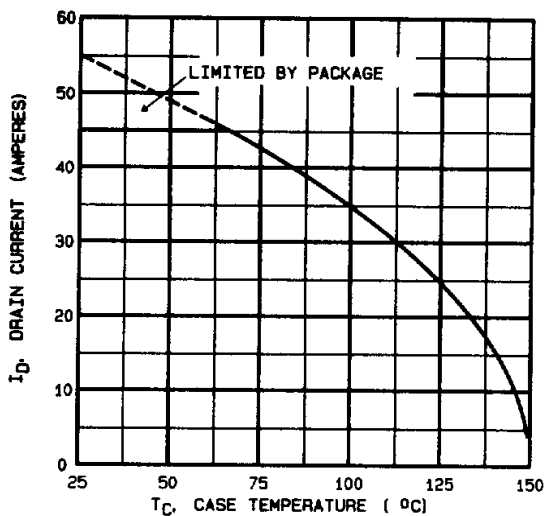
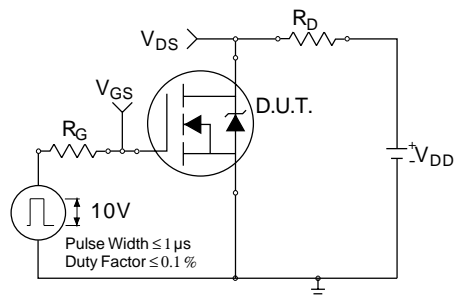


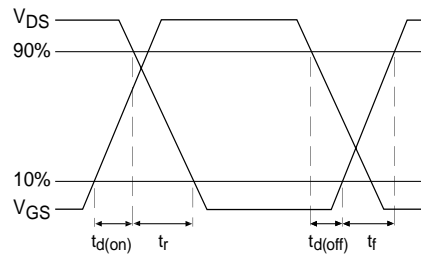
Fig 8. Maximum Safe Operating Area



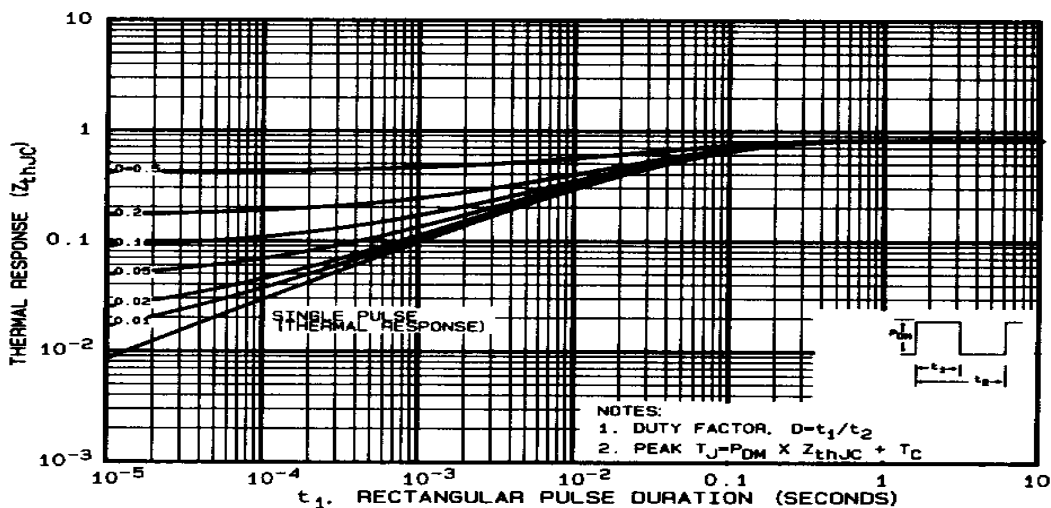
**Fig 9.** Maximum Drain Current Vs. Case Temperature



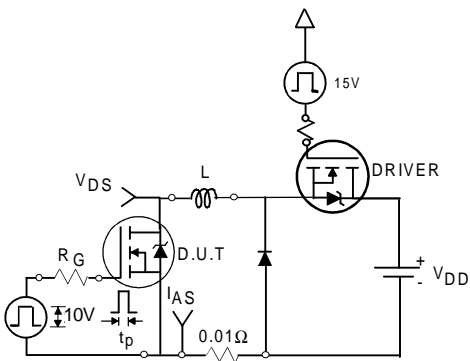
**Fig 10a.** Switching Time Test Circuit



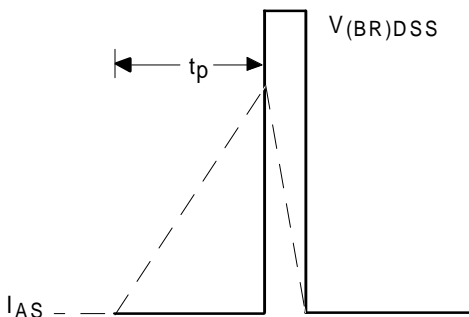
**Fig 10b.** Switching Time Waveforms



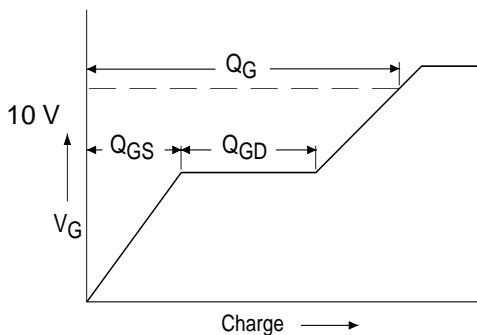
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



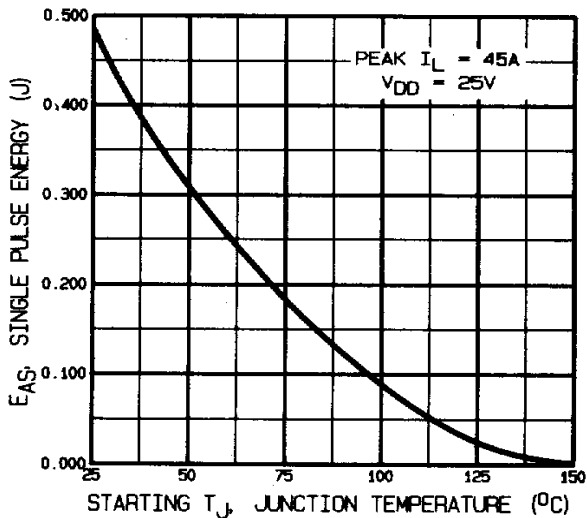
**Fig 12a.** Unclamped Inductive Test Circuit



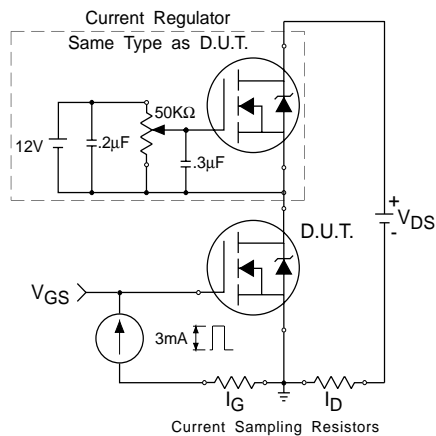
**Fig 12b.** Unclamped Inductive Waveforms



**Fig 13a.** Basic Gate Charge Waveform



**Fig 12c.** Maximum Avalanche Energy  
Vs. Drain Current

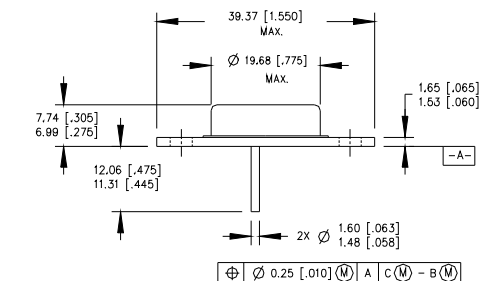


**Fig 13b.** Gate Charge Test Circuit

## Foot Notes:

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = 25V$ , starting  $T_J = 25^{\circ}C$ ,  
Peak  $I_L = 45A$ ,
- ③  $I_{SD} \leq 45A$ ,  $di/dt \leq 200A/\mu s$ ,  
 $V_{DD} \leq 60V$ ,  $T_J \leq 150^{\circ}C$   
Suggested  $R_G = 2.35 \Omega$
- ④ Pulse width  $\leq 300 \mu s$ ; Duty Cycle  $\leq 2\%$

## Case Outline and Dimensions —TO-204AE (Modified TO-3)



### PIN ASSIGNMENTS

- 1 - SOURCE
- 2 - GATE
- 3 - DRAIN (CASE)

### NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE TO-204AE.

